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ABSTRACT

This phase of a longitudinal study being conducted at Iowa State University compares the career paths of teacher education graduates with mathematics and science majors to elementary and other secondary area graduates. Participating in the study were teacher education graduates (N=842), out of a population of 1,411, who responded to a questionnaire at 1 year and 5 years following graduation. Over 60 percent of the mathematics/science graduates reported they had taught the first year following graduation, compared to 42 percent of the other secondary graduates and 68 percent of the elementary education graduates. After 5 years the percentage of mathematics and science graduates still teaching had dropped to 51 percent, while the percentage of other secondary and elementary graduates teaching had remained constant. Nonteaching mathematics and science graduates were more frequently employed in professional positions other than teaching, and they most often cited better salaries and career opportunities in nonteaching jobs as the reason for not teaching. Results suggest that unless newly certified mathematics and science teachers are retained in the teaching profession, the current shortage of qualified teachers in these subject areas will become more severe. (LL)

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Career Paths of Mathematics and Science Teacher Education Graduates Compared to Elementary and Other Secondary Graduates

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Career Paths of Mathematics and Science Teacher Education Graduates Compared to Elementary and Other Secondary Graduates

INTRODUCTION

The supply of graduates from teacher education programs has rarely been in balance with the demand for new teachers in all teaching areas. During the past two decades, there has been a significant decline in the number of newly certified mathematics and science teachers (Blosser, 1984; Houndshell & Griffin, 1989; Howe & Gerlovich, 1981; National Center for Educational Statistics, 1983; National Science Board, 1987; Swartz, 1979; Yager, 1980). At the same time, the demand from the business sector for trained scientists and mathematicians has continued to increase (Guthrie & Zusman, 1982). The problem is further compounded by a national trend for secondary schools to increase academic requirements in these subject areas, thus creating an additional demand for mathematics and science teachers (Gardner & Yager, 1983). The retention of newly certified mathematics and science teachers is vital to maintaining adequate numbers of qualified teachers in these fields when the demand is high and the supply of graduates is low. According to Darling-Hammond (1984), in 1981 less than half of the newly hired science and mathematics teachers were certified or eligible for certification in the subjects they were teaching.

A review of the literature indicated a lack of information about career paths of science and mathematics teacher education graduates as compared to other education graduates. Studies of teacher attrition have generally not differentiated teachers by major (Chapman & Green, 1986; Heyns, 1988; Mark & Anderson, 1978), although the retention of newly certified teachers in fields with low supply is essential to maintaining sufficient numbers of qualified teachers in all teaching areas.

PURPOSE

The purpose of this phase of the study was to examine career paths of teacher education graduates by teaching major, and thus provide empirical data on the employ-

ment patterns of graduates by area of teacher preparation. Because of the continuing concern about the supply of mathematics and science teachers, emphasis was placed on comparing science/mathematics graduates to other teacher education graduates. In addition, reasons given by nonteachers for not teaching five years following graduation were examined and compared by teaching major.

METHODS

Data from the comprehensive longitudinal study of teacher education graduates at Iowa State University were used to compare the career paths of mathematics and science teachers to other teacher education majors for five years following graduation. The sample consisted of 842 teacher education graduates out of the population of 1411 (60%) who responded to a questionnaire five years following graduation. Data in the present study were collected from 1985 through 1989.

Respondents were coded into three groups based on teaching major. The mathematics/science group (N=51) consisted of graduates in mathematics (N=15), biology (N=26), chemistry (N=7), physics (N=2), and earth science (N=1). Majors in other secondary subjects were coded as a second group (N=432), and elementary education graduates comprised the third group (N=359). Seventy-five percent (N=632) of the total sample and 65 percent (N=33) of the graduates in mathematics/science were female. The distributions of teacher education graduates by teaching major are presented in Table 1.

Because the variables were nominal, chi-square analyses were used to compare the career paths of the three groups of teacher education graduates (Tables 2, 4, and 5). Since respondents could indicate more than one reason for not teaching, only frequency distributions were reported for this variable (Table 3).

TABLE 1
Distribution of Teacher Education Graduates (1985-1989) by Teaching Area of Specialization (Major) and Gender

MAJOR	FEMALE NUMBER PERCENT	MALE NUMBER PERCENT	TOTAL NUMBER PERCENT
Mathematics/science	33 64.7	18 35.3	51 6.1
Other secondary subjects	270 62.5	162 37.5	432 51.3
Elementary education	329 91.6	30 8.4	359 42.6
TOTAL	632 75.1	210 24.9	842 100.0

RESULTS

Employment Status One Year Following Graduation. The graduates were asked to provide their employment history for each of the five years following graduation. While 54 percent of the graduates responded that they had taught their first year following graduation, the graduates were not equally distributed across teaching majors. There were significant differences in the employment status distribution of graduates by teaching major for the entire sample and for females and males (Table 2). Over 60 percent of the mathematics/science graduates reported they had taught the first year following graduation, compared to 42 percent of the other secondary graduates and 68 percent of the elementary education graduates (Chi-square=52.93, df=2, $p < 0.001$). A lower percentage of females, as compared to males, were employed in mathematics/science and other secondary subjects one year following graduation. For example, 54 percent of the female mathematics/science graduates and 72 percent of the male mathematics/science graduates reported teaching the first year after graduation (Table 2). The comparisons of the distributions of the one-year employment status by teaching major were significant for both females (Chi-square=47.31, df=2, $p < 0.001$) and males (Chi-square=7.52, df=2, $p < 0.05$).

TABLE 2

Employment Status of All Graduates and Female and Male Graduates One Year Following and Five Years Following Graduation by Major

	ALL GRADUATES				FEMALES				MALES			
	MATH/SCI	OTH SEC	ELEM	TOTAL	MATH/SCI	OTH SEC	ELEM	TOTAL	MATH/SCI	OTH SEC	ELEM	TOTAL
ONE YEAR[a]												
Teaching	31	180	238	449	18	106	219	343	13	74	19	106
	60.8	42.0	67.8	54.0	54.5	39.7	68.0	55.1	72.2	45.7	65.5	50.7
Not teaching	20	249	113	382	15	161	103	279	5	88	10	103
	39.2	58.0	51.6	46.0	45.5	60.3	32.0	44.9	27.8	54.3	34.5	49.3
Total	51	429	351	831	33	267	322	622	18	162	29	209
	6.1	51.6	42.2	100.0	5.3	42.9	51.8	100.0	8.6	77.5	13.9	100.0
	x^2 = 52.93***				x^2 = 47.31***				x^2 = 7.52*			
	11 missing observations				10 missing observations				1 missing observation			
FIVE YEARS												
Teaching	26	180	241	447	15	112	220	347	11	68	21	100
	51.0	41.7	67.3	53.2	45.5	41.5	66.9	54.9	61.1	42.0	72.4	47.8
Not teaching	25	252	117	394	18	158	109	285	7	94	8	109
	49.0	58.3	32.7	46.8	54.5	58.5	33.1	45.1	38.9	58.0	27.6	52.2
Total	51	432	358	841	33	270	329	632	18	162	29	209
	6.1	51.4	42.6	100.0	5.2	42.7	52.1	100.0	8.6	77.5	13.9	100.0
	x^2 = 51.84***				x^2 = 39.86***				x^2 = 10.52*			
	1 missing observation				0 missing observations				1 missing observation			

[a] One year employment status was taken from respondents' employment history at five years following graduation.

* $p > 0.05$

** $p > 0.01$

*** $p > 0.00$

These results indicate that, when compared on one-year employment status, mathematics/science teacher education graduates resembled elementary graduates more than graduates in other secondary subjects. Mathematics and science education graduates and elementary education graduates were more likely than other secondary subject area graduates to be teaching at one year following graduation. This may have been due in part to a greater demand for teacher education graduates in these areas of specialty.

Employment Status Five Years Following Graduation. Respondents were asked to classify their current employment status five years following graduation as either teaching or nonteaching. After five years, 53 percent of all respondents were still teaching (Table 2). As with the one year employment status, at five years, the graduates were not equally distributed across teaching majors (Chi-square=51.84, df=2, $p < 0.00$). Comparing five-year employment status by teaching major also indicated significant differences in distribution for females (Chi-square=39.86, df=2, $p < 0.001$) and males (Chi-square=10.52, df=2, p=0.01) (Table 2).

It is interesting to note that, while the number of graduates who were teaching at five years, as compared to one year, remained the same for other secondary subject graduates (n=180) and increased from 238 to 241 for elementary education graduates, the number of mathematics/science graduates who were teaching decreased 16 percent from 31 graduates to 26. In contrast to one year data, at five years, the comparison of employment status showed that for all respondents, mathematics/science graduates resembled other secondary graduates more than elementary education graduates. The percentage decrease in the number of mathematics/science teachers who were still teaching at five years was similar for both females (17%) and males (15%).

Figure 1 presents percentages of graduates teaching in each of the three groups of teaching majors for five years following graduation. It illustrates the relative stability of the percentage of other secondary and elementary education graduates who were still teaching, while the percentage of mathematics/science graduates teaching dropped substantially two years following graduation.

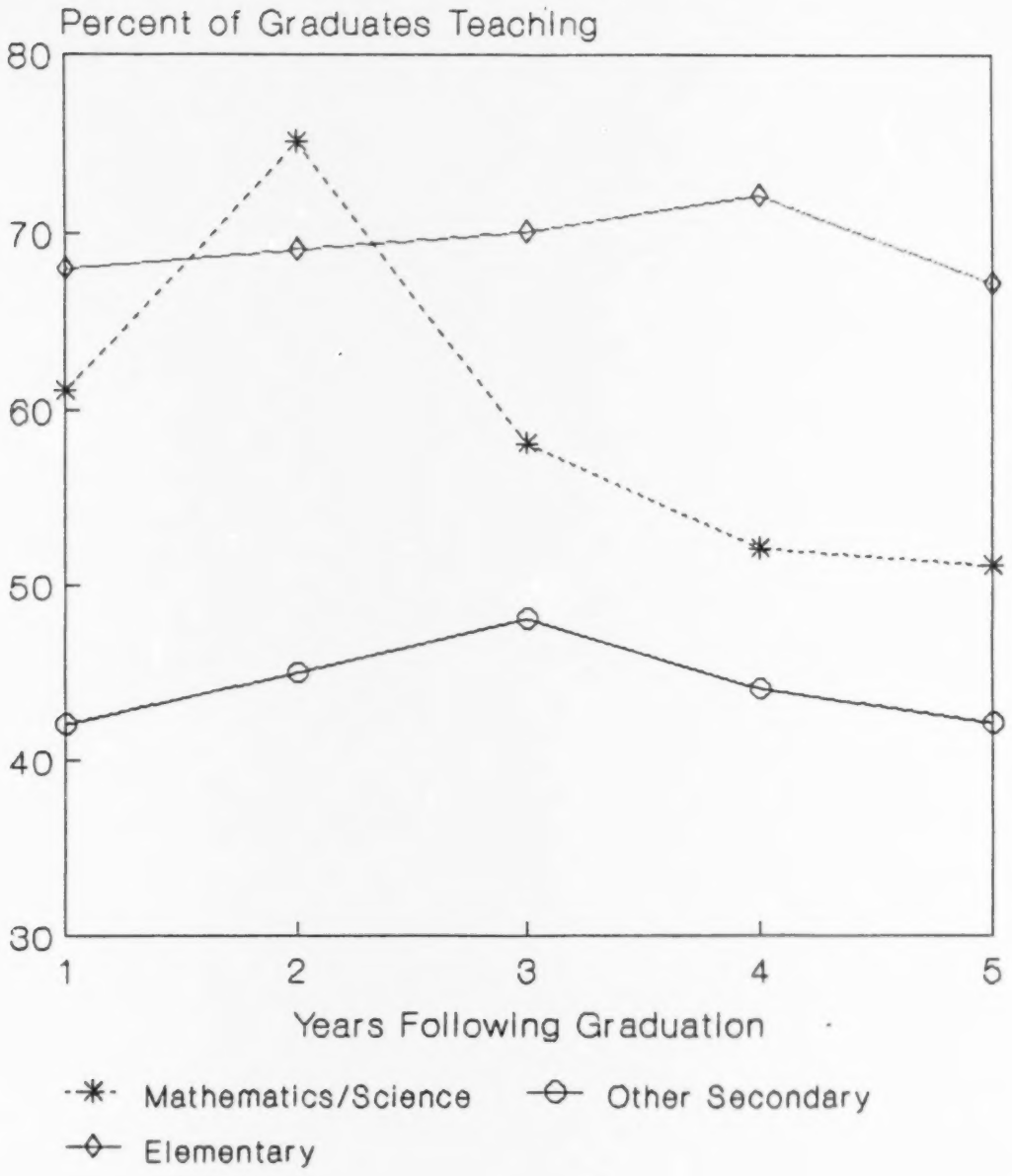

Figure 1
Employment Status by Teaching Major

Graduates not teaching at five years were asked to indicate reasons that contributed to their decisions not to teach. The responses of the three groups of graduates are presented in Table 3. Better salaries and career opportunities in nonteaching jobs was the most frequently cited reason reported by science/mathematics graduates (58%) and other secondary graduates (46%), while family obligations (43%) was most often cited by elementary graduates. Despite reported shortages of mathematics/science teachers, three graduates (25%) in these teaching majors reported an inability to find a teaching position.

There also appeared to be differences in the occupations reported by these nonteaching graduates at five years following graduation. Nonteaching mathematics/science graduates most frequently held other professional positions (42%). Other secondary graduates most often listed sales and business-related occupations (19%) or other professional positions (17%), while elementary graduates were homemakers (27%) or were employed in clerical jobs (18%).

Career Plans. Respondents were coded into three groups based on their future employment plans. One group consisted of graduates who planned to be teaching at ten years following graduation, a second group planned to remain in education but not as teachers, and a third group of graduates planned to be employed outside of the education profession. When asked about their future employment plans, 37 percent of the mathematics/science graduates, 28 percent of the other secondary graduates, and 52 percent of the elementary graduates planned to teach (Chi-square = 59.65, df=4, $p < 0.001$) (Table 4). The career plans for females and males are also presented separately in Table 4. While there was a general decrease in the percentage of all graduates planning to teach, the decrease was greater for males than females.

TABLE 3
Reasons for Not Teaching at Five Years by Major for 1987-89 Graduates

REASON	SCIENCE/ MATHEMATICS N	SCIENCE/ MATHEMATICS PCT OF CASES[a] (n=12)	OTHER SECONDARY SUBJECTS N	OTHER SECONDARY SUBJECTS PCT OF CASES[a] (n=112)	ELEMENTARY EDUCATION N	ELEMENTARY EDUCATION PCT OF CASES[a] (n=68)
Graduate study	2	16.7	18	13.0	6	8.8
Could not find a teaching position	3	25.0	42	30.4	24	35.3
Family obligations	2	16.7	20	14.5	29	42.6
Had not planned to teach	1	8.3	14	10.1	3	4.4
Better salaries and career opportunities in other fields	7	58.3	64	46.4	20	29.4
Inadequate salaries	2	16.7	33	23.9	12	17.6
General working conditions	0	0.0	24	17.4	4	5.9
Student-related	2	16.7	38	27.5	3	4.4
Feelings of ineffectiveness	0	0.0	18	13.0	4	5.9
Administrator-related	1	8.3	12	8.7	7	10.3
Lack of respect	0	0.0	18	13.0	2	2.9
Emotional aspects	1	8.3	20	14.5	5	7.4
Lack of support from parent/community	0	0.0	11	8.0	0	0.0
Lack of advancement opportunities	2	16.7	28	20.3	4	5.9

[a] All items were not available for the five year period. The "PCT OF CASES" column contains the percentage of respondents from the latest three years who expressed a particular reason. More than one reason could be indicated.

Only 29 percent of the male mathematics/science graduates planned to be teaching at ten years, while 41 percent of the female mathematics/science graduates planned to teach. Of the original 51 mathematics/science teacher education graduates, 18 (37%) of those responding planned to be teaching in the next five years. As shown in Table 4, only 13 female and 5 male mathematics and science graduates planned to teach ten years following graduation.

Employment Pattern by Teaching Major. The respondents were next classified into four groups based on their five year employment pattern. One group consisted of graduates who entered teaching either the first, second, or third year following graduation and continued teaching through the fifth year. The second group reported they had never taught during the five years following graduation. A third group entered teaching the first year following graduation, left before five years, and did not reenter. Graduates with other combinations of employment patterns were classified as a fourth group, which consisted of those who either entered, left, and reentered teaching during the five years or those who entered the fourth or fifth year.

The comparisons of five year employment patterns of the four groups of teacher education graduates by teaching major are presented in Table 5. A higher percentage of elementary education graduates (54%) had taught continuously, followed by mathematics/science graduates (41%), and other secondary subject graduates (33%). However, a higher percentage of mathematics/science teachers (22%) had taught and left when compared to other secondary teachers (19%) and elementary education teachers (18%). These results are consistent with previous findings of a lower percentage of mathematics/science teacher education graduates employed as teachers five years following graduation, as compared to graduates who were teaching at one year. A greater proportion of males than females in all teaching categories had taught continuously since graduation.

TABLE 4

Career Plans of Teacher Education Graduates by Major

	ALL RESPONDENTS				FEMALES				MALES			
	MATH/SCI	OTH SEC	ELEM	TOTAL	MATH/SCI	OTH SEC	ELEM	TOTAL	MATH/SCI	OTH SEC	ELEM	TOTAL
Teaching												
Number	18	115	179	312	13	75	169	257	5	40	10	55
Percent	36.7	27.7	51.9	38.6	40.6	29.1	53.1	42.3	29.4	25.5	37.0	27.4
Education-Related Not Teaching												
Number	4	37	43	84	3	26	35	64	1	11	8	20
Percent	8.2	8.9	12.5	10.4	9.4	10.1	11.0	10.5	5.9	7.0	29.6	10.0
Outside Education												
Number	27	263	123	413	16	157	114	287	11	106	9	126
Percent	55.1	63.4	35.7	51.1	50.0	60.9	35.8	47.2	64.7	67.5	33.3	62.7
Total												
Number	49	415	345	809	32	258	318	608	17	157	27	201
Percent	6.1	51.3	42.6	100.0	5.3	42.4	52.3	100.0	8.5	78.1	13.4	100.0
	x^2 = 59.65***				x^2 = 38.63***				x^2 = 17.52*			
	33 missing observations				24 missing observations				9 missing observation			

[a] One year employment status was taken from respondents' employment history at five years following graduation.

* $p > 0.05$

** $p > 0.01$

*** $p > 0.001$

TABLE 5

Five Year Employment Pattern of Teacher Education Graduates by Major

	ALL RESPONDENTS				FEMALES				MALES			
	MATH/SCI	OTH SEC	ELEM	TOTAL	MATH/SCI	OTH SEC	ELEM	TOTAL	MATH/SCI	OTH SEC	ELEM	TOTAL
Always Taught												
Number	21	143	191	355	13	83	172	268	8	60	19	87
Percent	41.2	33.3	54.3	42.7	39.4	31.1	53.3	43.0	44.4	37.0	65.5	41.6
Never Taught												
Number	11	153	43	207	7	98	39	144	4	55	4	63
Percent	21.6	35.7	12.2	24.9	21.2	36.7	12.1	23.1	22.2	34.0	13.8	30.1
Taught and Left												
Number	11	81	63	155	9	44	59	112	2	37	4	43
Percent	21.6	18.9	17.9	18.6	27.3	16.5	18.3	18.0	11.1	22.8	13.8	20.6
Other Combinations												
Number	8	52	55	115	4	42	53	99	4	10	2	16
Percent	15.7	12.1	15.6	13.8	12.1	15.7	16.4	15.9	22.2	6.2	6.9	7.7
Total												
Number	51	429	352	832	33	267	323	623	18	162	29	209
Percent	6.1	51.6	42.3	100.0	5.3	42.9	51.8	100.0	8.6	77.5	13.9	100.0
	$x^2 = 65.05$***				$x^2 = 57.51$***				$x^2 = 15.87$*			
	10 missing observations				9 missing observations				1 missing observation			

* $p > 0.05$

** $p > 0.01$

*** $p > 0.001$

SUMMARY AND CONCLUSIONS

The primary purpose of this study was to compare the career paths of mathematics and science graduates from the teacher preparation program at Iowa State University to the career paths of graduates in elementary education and other secondary areas. An examination of employment status of teacher education graduates at one year following graduation indicated that the highest percentage of elementary education graduates were teaching (68%), followed by mathematics/science majors (61%) and other secondary subject majors (42%). However, by five years following graduation, the percentage of mathematics/science graduates still teaching had dropped to 51 percent, while the percentage of other secondary and elementary graduates teaching had remained virtually the same as at one year following graduation. When asked their future employment plans, only 37 percent of the mathematics/science graduates planned to be teaching at ten years.

Nonteaching respondents also differed across teaching majors on current occupations and reasons for not teaching. Nonteaching mathematics/science graduates were more frequently employed in professional positions other than teaching and most often cited better salaries and career opportunities in nonteaching jobs as the reason for not teaching.

A comparison of five year employment patterns of teacher education graduates showed that mathematics/science teachers were more likely to have taught and left the teaching profession than other graduates. This decrease of mathematics/science graduates seems a particular problem at a time when the supply of graduates is low in comparison to demand.

The results of this study indicate that mathematics/science teachers semm to be leaving teaching early in their careers for professional occupations with better salaries and opportunities. Unless newly certified mathematics and science teachers are retained in the teaching profession, the current shortage of qualified teachers in these subject areas will become more severe.

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